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Aquatic Invertebrate Monitoring at Homestead National Monument of America

1996-2011 Trend Report

Natural Resource Technical Report NPS/HTLN/NRTR—2012/612

ON THE COVER
Cub Creek, Homestead National Monument of America, Nebraska
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David E. Bowles and Myranda K. Clark

National Park Service
The Heartland I&M Network and Prairie Cluster Prototype Monitoring Program
Wilson's Creek National Battlefield
6424 West Farm Road 182
Republic, MO 65738

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Abstract

This report summarizes aquatic invertebrate monitoring data collected from Cub Creek, Homestead National Monument of America (HOME) from 1996-2011 and evaluates the data with respect to trend. Invertebrates were collected using Hester-Dendy multiplate samplers placed at two sampling sites on Cub Creek. Additionally, hourly readings of water quality (temperature, dissolved oxygen, specific conductance, pH, turbidity) were recorded at least 24 hours prior to sampling at both the upper and lower monitoring sites using data loggers. Water quality measurements were generally consistent and typical for streams of this size in the region. Invertebrate community metrics from 2005-2011, including taxa richness, Ephemeroptera, Plecoptera, Trichoptera (EPT) richness, Shannon Diversity Index, Shannon Evenness Index, and Hilsenhoff Biotic Index (HBI) generally did not exceed control chart limits based on historical data collected from 1996-2004. The non-parametric Mann-Kendall trend test applied to each of the five metrics found no significant trends. The results of invertebrate monitoring clearly show that stream integrity has not diminished since 1989, although data exhibited substantial variation among years. Given the known anthropogenic disturbances in Cub Creek upstream of the park, it is likely that the aquatic invertebrate communities in Cub Creek within HOME are mildly impaired. There are few available options to park management for mitigating this situation, largely because the impacts to water quality originate upstream of the park boundaries. For the past 15 years, HOME management has worked with the local National Resources Conservation Service (NRCS) and the Farm Services Agency (FSA) to promote conservation in the Cub Creek watershed. Many private landowners have enrolled eligible acreage in conservation programs that likely benefit water quality in Cub Creek. Maintaining and advancing these relationships will continue to benefit Cub Creek. Maintaining in-stream habitat and riparian zone integrity will further aid in maintaining the integrity of Cub Creek in the park. Aquatic invertebrate monitoring in Cub Creek provides a sound tool to recognize both deterioration and chronic decline of water quality, and it will be useful to ensure water quality in the stream does not degrade further.

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Introduction

Homestead National Monument of America (HOME) is located in Omernick's (1987) Central Great Plains ecoregion. The monument is 0.79 km^2 in area, including 0.40 km^2 of restored tallgrass prairie. Natural vegetation of the park is bluestem prairie (Kuchler 1964, Stubbendieck and Willson 1986). The Cub Creek basin is located in the loess plains of southeastern Nebraska and encompasses 374 km^2 (Harris *et al*. 1991). Cub Creek meanders through the western half of HOME, exiting the park twice before finally leaving the park and joining the Big Blue River approximately 3 km downstream. The riparian zone of Cub Creek within monument boundaries consists primarily of hardwood forest. Flood control and sediment dams have been constructed upstream of the park. Additionally, development and agricultural practices in the basin upstream and adjacent to Cub Creek, including row crops and their associated management and water removal, have a significant potential for disrupting the ecological integrity and functioning of the Cub Creek ecosystem. Based on historical water chemistry data (1960-1997), agricultural practices and industrial discharges in the watershed negatively impacted water quality in Cub Creek (NPS Water Resources Division 1999). To address these concerns, the National Park Service (NPS) began monitoring the aquatic invertebrates of Cub Creek within HOME in 1989 (Harris *et al*. 1991). During the period 1992-1995, the Midwest Regional Office of NPS funded an aquatic invertebrate sampling effort within the creek. However, sampling was sporadic and mostly outside the collection season of interest (summer). Concerted monitoring efforts began in 1996-1997, following creation of the Prairie Cluster Prototype Long-term Ecological Monitoring Program, now known as the Heartland Inventory and Monitoring Network and Prairie Cluster Prototype Monitoring Program. Peitz and Cribbs (2005) reported on status and trends of the aquatic invertebrate community at HOME from inception of monitoring through 2004. Bowles (2009) reported on the monitoring conducted from 2005 to 2007. The purpose of this report is to summarize aquatic invertebrate monitoring data collected from 1996-2011 and assess that data with respect to trend.

Methods

Methods and procedures used in this report follow Bowles *et al*. (2008), Monitoring Protocol for Aquatic Invertebrates of Small Streams in the Heartland Inventory & Monitoring Network. For a summary of field and laboratory methods used prior to 2005, refer to Peitz and Cribbs (2005). Five Hester-Dendy multiplate samplers (0.09 m^2) were deployed at each of two sampling sites on Cub Creek (Figure 1). Hester-Dendy samplers were placed in the stream for approximately 30 days, retrieved, and field processed by HOME staff. Samples were then sorted in the laboratory following a subsampling routine described in Bowles *et al*. (2008), and taxa were identified to the lowest practical taxonomic level (usually genus) and counted. Because the Hester-Dendy samplers are an artificial medium, qualitative physical habitat variables were not collected. In conjunction with invertebrate samples during 2006-2007 and 2010, hourly readings of water quality parameters (temperature, dissolved oxygen, specific conductance, pH, and turbidity) were continuously recorded at least 24 hours at both the upper and lower monitoring sites using calibrated data loggers or sondes (YSI 6600, 6920). Static water quality readings recorded prior to 2006 are summarized in Peitz and Cribbs (2005).

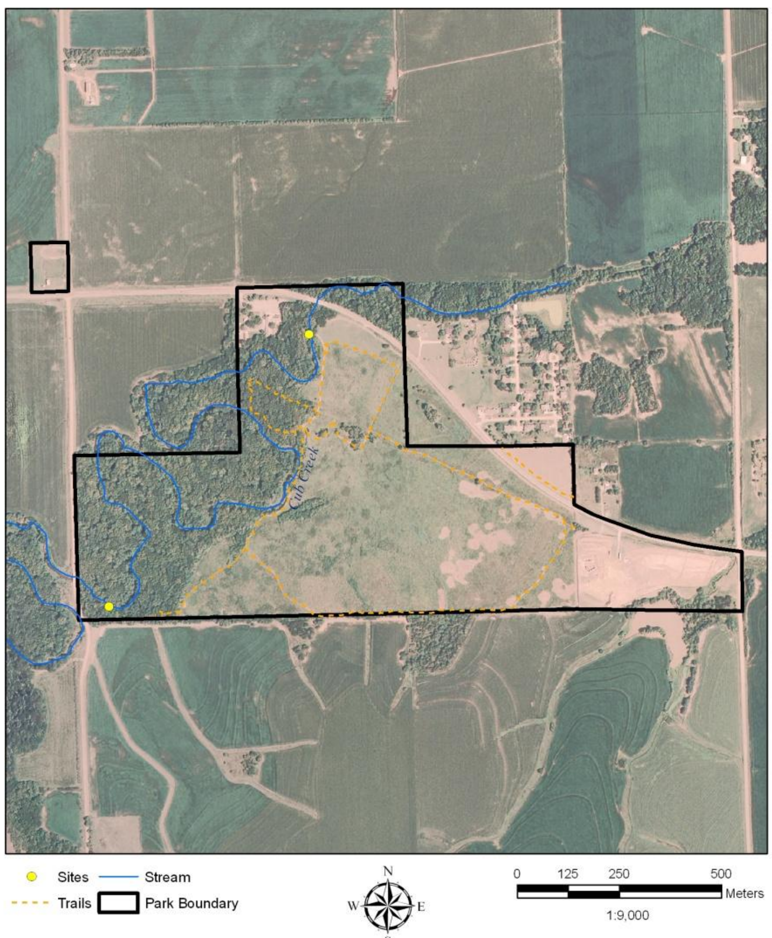

Figure 1. Aquatic Invertebrate monitoring sites at Homestead National Monument of America.

Univariate control charts were established to illustrate the general trend of invertebrate community metrics and provide a visual tool for managers to determine which variables may require more in-depth analyses or management action in the future. Control charts plot a characteristic through time with reference to its expected value. Upper or lower thresholds specify amounts of variability beyond what would normally be expected and indicate when a system is going ‘out of control’ (Morrison 2008). Control charts as used here contain a control limit of (mean ± 1.86 standard deviations) for those community metrics that respectively decrease or increase due to stressors (Bowles 2009). This specified threshold serves as an indicator to suggest biologically important change may be occurring. Setting a control chart threshold equal to 1.86 standard deviations is analogous to significance tests at a critical value of 0.05 for one-tailed tests (since we are only interested in change in one direction). The student’s *t*-distribution (df = 8; because 9 years were used as a baseline) was used to determine the one-tailed area. A critical value of 0.05 is widely accepted as the ‘standard’ in significance testing approach and indicates that one out of every 20 data points will exceed this limit if the population is not changing, which is our assumption. The specified control limit serves as an indicator to suggest biologically important change may be occurring.

Only data collected from 1996-2004 during the July-August index period were used to determine the control limits, because the field methods used to collect samples and the sampling periods of those years were most similar to those described in the present protocol (Bowles *et al*. 2008, Bowles 2009). The single exception was for 1998 when the only available data were from September. However, the data used were from samplers retrieved on September 10, so the plates were largely colonized during the index period. This contrasts with the approach used by Peitz and Cribbs (2005) who summarized all historical data, including that collected outside of the current index period. Data from 1989 are included in the plots of the historical data only as a reference. The primary purpose of sampling to date with respect to control chart construction has been to establish a baseline and evaluate natural variability. Data collected from 2005-2011 are evaluated against the data collected during the baseline period.

A trend analysis of invertebrate metrics data across years (1996-2011) was conducted using a non-parametric Mann-Kendall trend test (α=0.05) (Time Trends software, version 3.0, NIWA 2010). The non-parametric Mann-Kendall test is directly analogous to linear regression, but it does not assume any particular distributional form and it tests whether Y values tend to increase or decrease with time (Esterby 1993, Helsel and Hirsch 2002, Stark and Fowles 2006). Stark and Fowles (2006) recommended the Mann-Kendall test over other trend tests for the evaluation of stream invertebrate samples. The Mann-Kendall test complements, rather than provides an alternative to, the control chart approach. Control charts, as constructed with a single control limit, guard against the indicators declining, but do not provide any thresholds for meaningful changes in the opposite (i.e., improving) direction. The Mann-Kendall test can detect either a positive or negative trend. This test, however, evaluates long-term trend over the entire data series, whereas control charts will draw attention to more rapid change that occurs over only a few years.

Results

Water quality measurements (Table 1) were generally typical for streams in this region (Harris *et al*. 1999, Poulton *et al*. 2007) although dissolved oxygen for 2007 was below state standards for surface water (Table 2). Fouling of the dissolved oxygen sensor membrane that was not apparent during post-calibration may have caused these low reading. Turbidity was consistently high among years, but Nebraska does not have a turbidity standard for surface waters. Many other states in the region do have turbidity standards and turbidity levels of <10 NTU are considered to be optimal for aquatic life (Brown and Czarnezki, undated). Generally, turbidity levels >100 NTU are considered poor. The observed turbidity in Cub Creek is unlikely to be similar to historic, pre-settlement levels and should generally be viewed as abnormally high (Rabeni 1996). Water quality measurements related to invertebrate monitoring at Cub Creek historically were taken as static readings using hand-held water quality meters, and therefore comparison of the historical data with the most recently collected data is not appropriate. Peitz and Cribbs (2005) summarized water quality data for monitoring years 2002 and 2003, and their data are generally similar to those presented in Table 1.

Table 1. Water quality characteristics for Cub Creek, Homestead National Monument of America, 2006-2007, and 2010. Data were collected continuously with a calibrated data logger. Values are mean, standard deviation, and range. Dashes indicate missing data due to equipment failure.

Year	Sampling Site	Temperature (^oC)	Specific Conductance (µm/cm)	Dissolved Oxygen (mg/liter)	pH	Turbidity (NTU)
2006	Site 2	19.94	350.71	7.1	7.5	146.07
		1.14	5.94	0.12	0.01	5.57
		18.61-21.92	341-358	6.94-7.33	7.49-7.53	139.50-157.60
2007	Site 1	26.42	231.25	2.08	7.55	166.36
		1.2	10.26	0.76	0.02	3.89
		24.99-28.61	219-247	1.09-3.54	7.52-7.58	160.70-172.60
2007	Site 2	26.8	233.56	5.34	7.61	178.97
		1.5	7.93	0.75	0.03	3.43
		24.79-28.91	219-249	4.16-6.79	7.55-7.65	174.30-183.50
2010	Site 2	25.58	520	5.34	8.06	--
		0.02	0	0.19	0.04	--
		25.5-25.6	520-520	4.94-5.99	8.0-8.2	--
2010	Site 1	29.2	462	--	8.02	--
		0.49	2	--	0.02	--
		28-30	460-470	--	8.0-8.1	--

Table 2. Acceptable ranges for water quality parameters in Nebraska streams. Adapted from Nebraska Department of Environmental Quality (2009).

Water Quality Parameter	Acceptable Range
Temperature	0-32 ^{o}C
Dissolved Oxygen	24 hr minimum of 3 mg/liter for all life stages other than early life stages
Specific Conductance	<2,000 μS/cm
pH	6.5-9.0
Turbidity	No state standard[1]

[1] Turbidity <10 NTU during dry weather flows is considered acceptable to support aquatic life (Brown and Czarnezki, undated).

Control charts created for each metric show that the annual means for 2005-2011 generally did not exceed control limits (Figures 2-6). The exceptions were EPT richness in 2006 and 2010, Shannon's Evenness in 1996, and HBI from 1996 to 1998. No other mean metric values exceeded their respective control limits. A low HBI indicates a healthy community, so there is a single upper control limit, in contrast to a lower limit for all the other variables. Values for some years were near the warning threshold, but this likely only reflects the natural variability of the data rather than an indication of impairment. Metric values were highly variable among sampling years.

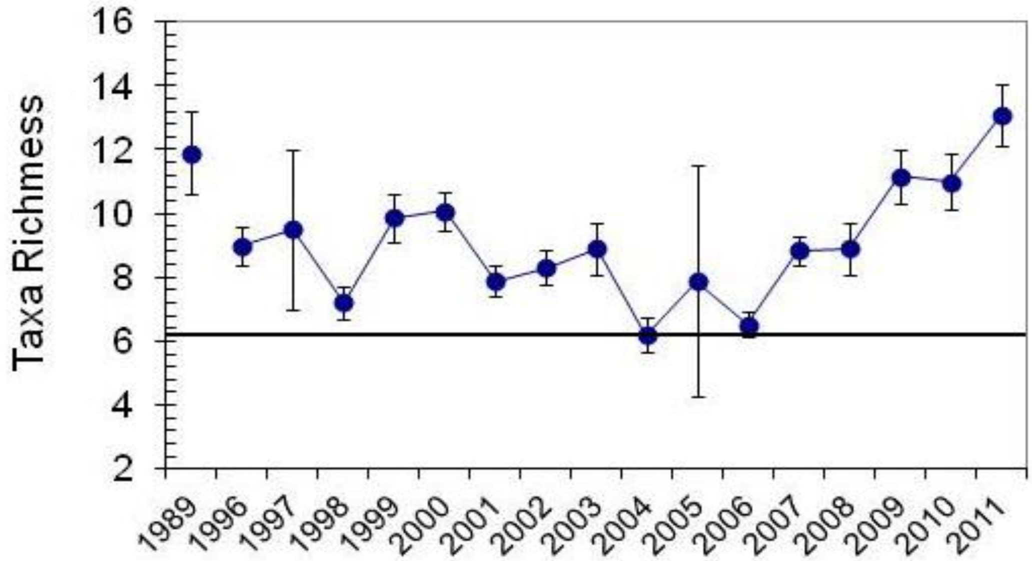

Figure 2. Control chart showing means and standard errors for taxa richness at Cub Creek, Homestead National Monument of America. The horizontal line represents the control limit corresponding to the Type I error rate of 0.05.

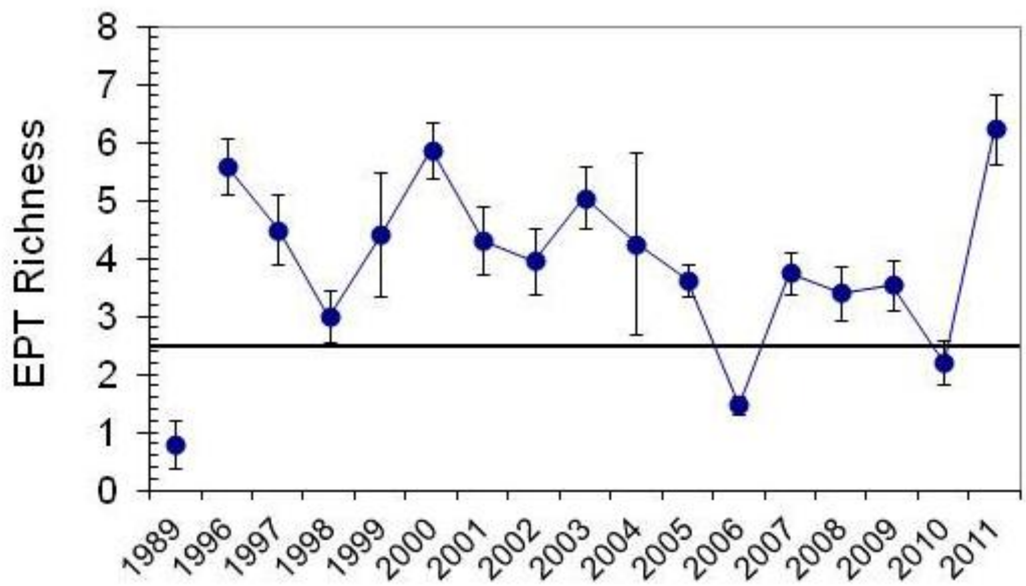

Figure 3. Control chart showing means and standard errors for Ephemeroptera, Plecoptera, Trichoptera (EPT) richness at Cub Creek, Homestead National Monument of America. The horizontal line represents the control limit corresponding to the Type I error rate 0.05.

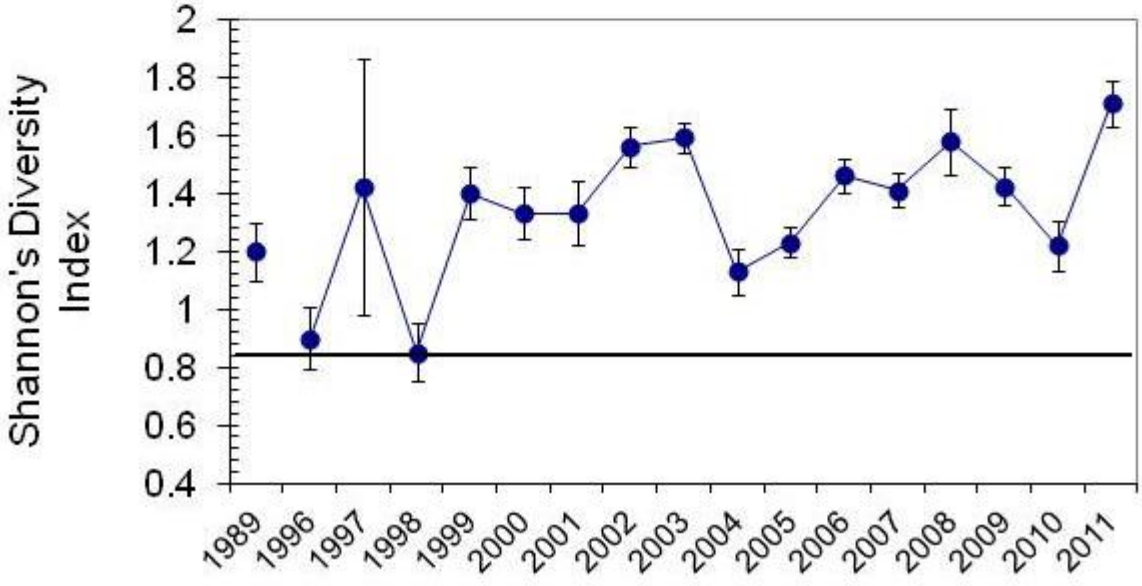

Figure 4. Control chart showing means and standard errors for Shannon's Diversity Index at Cub Creek, Homestead National Monument of America. The horizontal line represents the control limit corresponding to the Type I error rate of 0.05.

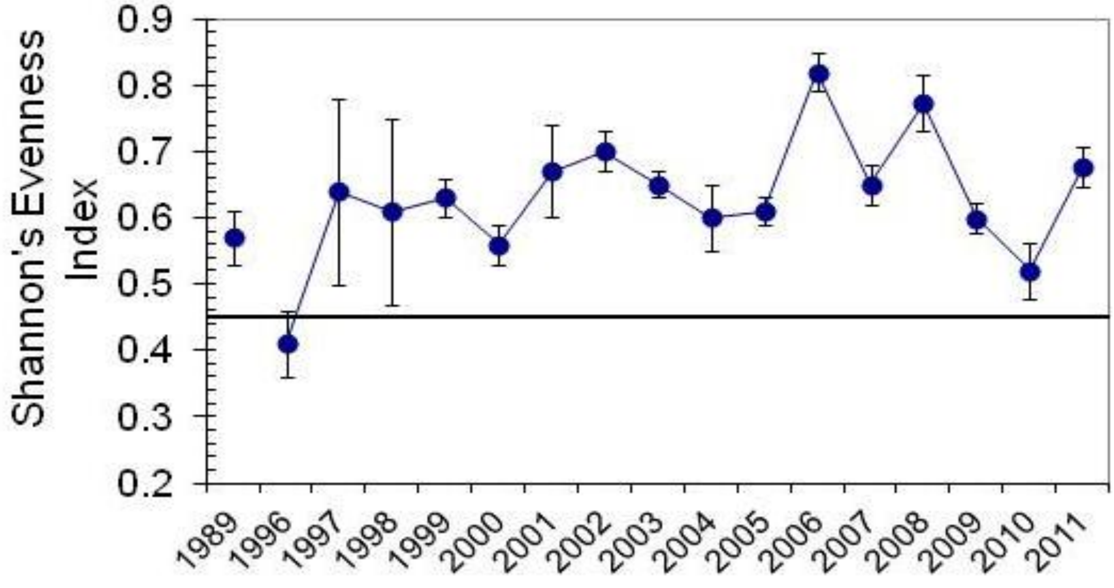

Figure 5. Control chart showing means and standard errors for Shannon Evenness at Cub Creek, Homestead National Monument of America. The horizontal line represents the control limit corresponding to the Type I error rate of 0.05.

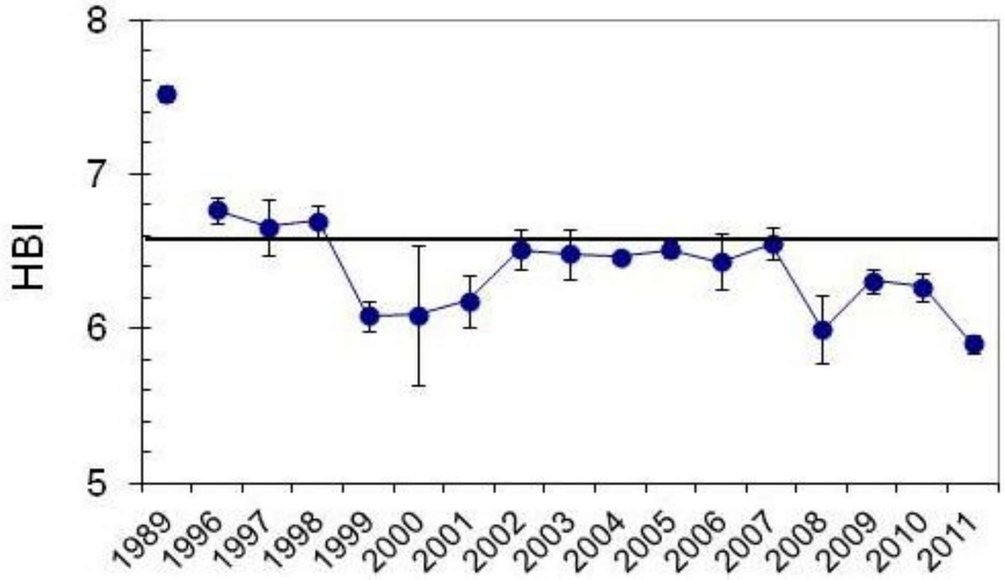

Figure 6. Control chart showing means and standard errors for Hilsenhoff Biotic Index for genera at Cub Creek, Homestead National Monument of America. The horizontal line represents the control limit corresponding to the Type I error rate of 0.05.

Mann-Kendall's trend test for each metric from 1996-2011 did not show any significant trend (all P-values ≥ 0.05) in those metrics (Table 3). Although none of the P-values were less than 0.05, those for EPT richness and HBI were close to that limit, and could be considered "marginally significant". Notably for EPT richness, the last data point collected is the highest of the entire data series. This apparent incongruity may be a function of using a nonparametric test based on ranks to analyze and a relatively small data series.

Table 3. Mann-Kendall trend statistic results for invertebrate metrics for Cub Creek, Homestead National Monument of America, Nebraska.

Parameter	Kendall Statistic	Z	P
Taxa richness	25	1.08	0.28
EPT richness	-42	-1.85	0.06
Shannon's diversity index	22	1.04	0.30
Shannon's evenness index	20	.86	0.39
HBI	-44	-1.94	0.05

Discussion

The NPS previously reviewed water quality data (1960-1997) for Cub Creek in the general area of HOME (NPS Water Resources Division 1999). This review reported that water quality in Cub Creek had been adversely impacted by human activities. Potential anthropogenic sources of pollutants in Cub Creek include municipal and industrial wastewater discharge, agricultural practices, quarrying, storm-water runoff, and recreational use. Dissolved oxygen, pH, cadmium, copper, lead, and zinc all exceeded their respective EPA criteria for the protection of freshwater aquatic life one or more times (NPS Water Resources Division 1999). Chemical pollutants including nitrates, beryllium, cadmium, chromium, lead, nickel, bis (2-ethylhexyl) phthalate, and atrazine exceeded their respective EPA drinking water criteria as well. Fecal-indicator bacteria concentrations and turbidity have also exceeded the WRD screening limits for freshwater bathing and aquatic life, respectively. The turbidity levels measured at Cub Creek were greater than 140 NTU. Pollutants in runoff and sedimentation typically have detrimental effects on less pollution tolerant aquatic invertebrate species. Although streams of the Great Plains region historically had seasonally turbid flows, agricultural practices over the past 150 years have degraded many small, perennial streams, such as Cub Creek, into constantly turbid streams to the detriment of their resident faunas (Rabeni 1996). The water quality data presented in this report are intended to describe the prevailing conditions that may influence the structure of invertebrate communities and may help explain variability between sampling periods (Bowles *et al*. 2008). They should not be used as an analytical tool in the strictest sense. Moreover, the water quality data collected using data loggers over a 24-hour period represents only a small snap-shot of the broader range of conditions possible over longer periods, and thus should be cautiously interpreted. Due to the limitations of using water quality data obtained with data loggers, the invertebrate community serves as a surrogate of the long-term water quality condition in Cub Creek.

Given the known anthropogenic disturbances in Cub Creek upstream of the park, it is likely that the aquatic invertebrate community in Cub Creek within HOME is mildly impaired. Taxa diversity is low at around 13 taxa per sample or less (this includes the large and tolerant dipteran family Chironomidae as a single taxon), placing it in the lowest 25th percentile of streams in Nebraska (Bazata 2007). Also, the diversity of Ephemeroptera (mayflies) and Trichoptera (caddisflies) is consistently low and those species that are present tend to be tolerant of disturbance (Bazata 2007). Plecoptera (stoneflies) have not been collected from Cub Creek. The biotic index indicates that the invertebrate community of Cub Creek is generally tolerant of disturbance (Bazata 2007). However, the results of invertebrate monitoring reported here show stream integrity has not diminished beyond that reported in earlier studies (Harris *et al*. 1991, Harris *et al*. 1999, Peitz and Cribbs 2005), although the data are variable. The results reported here are generally consistent with previous studies of Cub Creek (Harris *et al*. 1999), and they fall within the range of data reported for other streams in Nebraska (Bazata 2007, Nebraska Department of Environmental Quality 2006, Zelt and Frankforter 2003), and the region (MacFarlane 1983, Whiles *et al*. 2000, Hall *et al*. 2003, Kosnicki and Sites 2007, Poulton *et al*. 2007).

There are few available options to park management for mitigating this situation largely because the impacts to this invertebrate community and water quality in general originate upstream of the park boundaries. Continued establishment and widening of riparian buffer zones along Cub Creek upstream of the park will aid in protecting aquatic life in Cub Creek as well as in-stream habitat from local chemical runoff and sedimentation. Improved buffer zones will also reduce bank erosion within the monument by reducing stream velocity and the amount of water entering Cub Creek. For the past 15 years, HOME management has worked with the local National Resources Conservation Service (NRCS) and the Farm Services Agency (FSA) to promote conservation in the Cub Creek watershed. Many private landowners have enrolled eligible acreage in conservation programs that likely benefit water quality in Cub Creek. Maintaining and advancing these relationships will continue to benefit Cub Creek. The long history and continuing efforts of aquatic invertebrate monitoring in Cub Creek provide a sound tool to recognize both deterioration and chronic decline of water quality.

Literature Cited

Bazata, K. 2007. Nebraska Stream Classifications for the 2004-2005 Stream Biological Monitoring Program, Project Report. Nebraska Department of Environmental Quality, Lincoln, Nebraska.

Bowles, D. E. 2009. Aquatic invertebrate monitoring at Homestead National Monument of America: 2005-2007 trend report. Natural Resource Technical Report NPS/HTLN/NRTR—2009/242. National Park Service, Fort Collins, Colorado.

Bowles, D. E., M. H. Williams, H. R. Dodd, L. W. Morrison, J. A. Hinsey, C. E. Ciak, G. A. Rowell, M. D. DeBacker, and J. L. Haack. 2008. Monitoring Protocol for Aquatic Invertebrates of Small Streams in the Heartland Inventory & Monitoring Network. Natural Resource Report NPS/HTLN/NRR—2008/042. National Park Service, Fort Collins, Colorado.

Brown, D., and J. Czarnezki. Undated. Missouri streams fact sheet—chemical monitoring. Missouri Department of Conservation. Jefferson City, Missouri. 4 p.

Esterby, S.R. 1993. Trend analysis methods for environmental data. Environmentrics **4**:459-481.

Hall, D. L., B. S. Bergthold, and R. W. Sites. 2003. The influence of adjacent land use on macroinvertebrate communities of prairie streams in Missouri. Journal of Freshwater Ecology **18**:55-68.

Harris, M.A., B.C. Kondratieff, and T.P. Boyle. 1991. nvertebrate assemblages and water quality in six National Park units in the Great Plains. National Park Service, Water Resources Division, Fort Collins, Colorado.

Harris, M. A., B. C. Kondratieff, and T. P. Boyle. 1999. Macroinvertebrate community structure of three prairie streams. Journal of the Kansas Entomological Society **72**:402-425.

Helsel, D.R., and R.M. Hirsch. 2002. Statistical Methods in Water Resources Techniques of Water Resources Investigations, Book 4, chapter A3. U.S. Geological Survey.

Kosnicki, E., and R. W. Sites. 2007. Least-desired index for assessing the effectiveness of grass riparian filter strips in improving water quality in an agricultural region. Environmental Entomology **36**:713-724.

Kuchler, A.W. 1964. Potential natural vegetation map. National Atlas of the United States of America, U.S. Geological Survey.

MacFarlane, M. B. 1983. Structure of benthic macroinvertebrate communities in a Midwestern plains stream. Freshwater Invertebrate Biology **2**:147-153.

Morrison, L. W. 2007. Assessing the reliability of ecological monitoring data: Power analysis and alternative approaches. Natural Areas Journal **27**:83–91.

Morrison, L. W. 2008. The use of control charts to interpret environmental monitoring data. Natural Areas Journal **28**:66–73.

National Institute of Water and Atmospheric Research (NIWA). 2010. Time Trends software, version 3.0. Auckland, New Zealand.

National Park Service, Water Resources Division. 1999. Baseline water quality data inventory and Analysis: Homestead National Monument of America. National Park Service, Water Resources Division, Fort Collins, Colorado. 303pp.

Nebraska Department of Environmental Quality. 2006. 2005 Nebraska Surface Water Quality Monitoring Report. Water Quality Division, Lincoln, Nebraska.

Nebraska Department of Environmental Quality. 2009. Nebraska Administrative Code Title 117, Chapter 4 - standards for water quality.

Omernick, J. M. 1987. Ecoregions of the conterminous United States. Annals of the Association of American Geography **77**:118-125.

Peitz, D. G., and J. T. Cribbs. 2005. Bio-monitoring of Water Quality Using Aquatic Invertebrates and In-stream Habitat and Riparian Condition Assessments: Status Report for Cub Creek, Homestead National Monument of America, Nebraska 1989-2004 U.S. National Park Service, Heartland I&M Network and Prairie Cluster Prototype Monitoring Program, Wilson's Creek National Battlefield, Republic, Missouri.

Poulton, B. C., T. J. Rasmussen, and C. J. Lee. 2007. Assessment of biological conditions at selected stream sites in Johnson County, and Cass County and Jackson counties, Missouri, 2003 and 2004. U.S. Geological Survey Special Investigations Report 2007-5108.

Rabeni, C. F. 1996. Prairie legacies—fish and aquatic resources, Ch. 8. Pages 111-124, in Prairie Conservation: preserving North America's most endangered ecosystem. Fred B. Samson, Fritz L. Knopf (editors). Island Press, Washington, DC.

Stark, J. D., and C. R. Fowles. 2006. An approach to the evaluation of temporal trends in Taranaki state of the environment macroinvertebrate data. Report prepared for Taranaki Regional Council, Stratford, New Zealand.

Stubbendieck, J. L., and G. D. Willson. 1986. An identification of prairie in National Park units in the Great Plains. National Park Service, Midwest Regional Office, Omaha, Nebraska.

Whiles, M. R., B. L. Brock, A. C. Franzen, and S. C. Dinsmore, II. 2000. Stream Invertebrate Communities, Water Quality, and Land-Use Patterns in an Agricultural Drainage Basin of Northeastern Nebraska, USA. Environmental Management 26:563-576.

Zelt, R. B., and J. D. Frankforter. 2003. Water-quality assessment of the central Nebraska basins— entering a new decade. USGS Fact Sheet 013–03. US Geological Survey, Lincoln, Nebraska.

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